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THE PLANT DISEASE REPORTER

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Division of Mycology and Disease Survey

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BUREAU OF PLANT INDUSTRY

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THE PLANT DISEASE REPORTER

Issued by

THE PLANT DISEASE SURVEY

DIVISION OF MYCOLOGY AND DISEASE SURVEY

Vol. XXI Number 7

April 15, 1937

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TOBACCO DISEASES IN CANADA

G. H. Berkeley

Dr. Koch and myself have been making notes on diseases in our tobacco districts the last two years. Dr. Koch has found three seedling troubles not previously reported for Canada, namely, black leg, frenching, and root knot, and another, a brown root rot, symptoms of which appear to be unlike those of any tobacco seedling trouble reported. This brown root rot was present more commonly in steamed plant beds and was manifested by stunting, accompanied by general chlorosis. Root systems were stunted and discolored.

Black root rot, black leg, (found in several plant beds), damping off, chlorosis (cause unknown), and fleshy fungi (Coprinus spp.) were found in seed beds in addition to the diseases mentioned above.

A field survey in 1936 showed that though mosaic was widespread in distribution, it was by no means as prevalent as in 1935. Though a few individual fields showed as high as 50-75 percent mosaic, the average infection was considerably below that of recent years. In addition to mosaic, ring spot was found in a few fields but was rather unimportant. Brown root rot was severe in Essex and Kent Counties only where tobacco followed timothy or corn. It was observed that the Kelley variety was very susceptible to black root rot, whereas Harrow Velvet showed decided resistance. On the other hand, Harrow Velvet was very susceptible to brown root rot. In connection with brown root rot it was noted that Yellow Mammoth and White Stem Willow Leaf were decidedly susceptible, whereas White Mammoth and Bonanza showed decided resistance to it. In addition, black root rot, frenching, potash deficiency, sand drown, sunscald (severe in Delhi district) were found on several occasions in different districts. In Quebec, leaf spots, particularly angular leaf spot, were present. Wildfire was also a factor. A brown leaf spot which later turned white is tentatively considered to be a physiological spot, and this leaf spot was very general in Quebec, Delhi, Harrow districts, and at St. Catharines.

Our tobacco is grown in four main districts, namely, Essex and Kent, Ontario (dark and burley mainly), Norfolk, Ontario (flue-cured), and L'Assomption and Farnham, Quebec (Dark and cigar leaf). We found that mosaic is not the factor in Quebec that it is in Ontario. Whereas in Ontario mosaic overwinters in the soil and gives rise to infection in the new crop, this is by no means so important a factor in Quebec (L'Assomption district especially). Possibly the heavier soil, greater rainfall and severe winters in Quebec may account for this difference. (Dominion Laboratory of Plant Pathology, St. Catharines, Ontario).

POTATO DISEASES IN DADE COUNTY, FLORIDA, DURING THE 1936-37 SEASON

Geo. D. Ruehle

With the harvesting of more than 6,000 acres of Bliss Triumph potatoes, the Irish potato season in Dade County, Florida, is rapidly drawing to a close. With a few exceptions, the growers in this area have experienced a highly successful season. Yields of 275 to 300 bushels per acre were common. The exceptions were generally the result of planting seed infected either with late blight or scab, or were the result of severe insect infestations.

Rhizoctonia disease (Corticium vagum B. & C.) was considerably less evident this season than during the previous one. Injury from the disease was negligible on the growing crop and black scurf was of slight importance on the harvested tubers. During November and December the temperatures were higher and the soil drier than last year, which probably accounts for the lessened development of this disease.

Common scab (Actinomyces scabies (Thax.) Güssow) was much more prevalent than in any past year and on a few farms was the occasion for serious losses. On one farm of slightly more than 500 acres where untreated seed from a single source was planted, the scab infection ranged from 15 to 90 percent in different portions of the farm and averaged more than 50 percent for the whole. On other farms seed from the same source which was treated before planting produced crops with 10 to 50 percent scab infection. In several cases severe scab infection occurred which could not be traced to the use of infected seed. In most of these fields scab had occurred in a severe form two or three years previously, according to reports from growers. The majority of the fields escaped serious infection with less than 3 percent scab. The average for the section as a whole is estimated as 5 to 6 percent severe scab infection.

A superficial russetting of the tubers which was more pronounced at the distal end was very common and affected practically 100 percent of the crop in some fields, but did not seriously affect the grade.

In a comparative test of various seed treatments on scabby seed, carried out on the farm of the Sub-Tropical Experiment Station, the standard hot and cold formaldehyde treatments proved to be superior to any of the mercurials tested. Of the latter, the acid mercury dip gave nearly equal reduction of scab infection to the formaldehyde, and was much more efficacious than other standard mercurial treatments.

Late blight (Phytophthora infestans (Mont.) de Bary) was present again this season but did not spread over the entire section. The disease broke out simultaneously on three widely separated farms about the middle of December and spread very slowly to adjacent farms to the west of the foci of infection. The prevailing winds in the section are from the east. Intensive spraying or dusting with copper fungicides together with relatively warm and dry weather served to hold the disease in check and reductions in yield from this source were slight except on a few farms where control measures were not properly applied. The tuber-rot phase of the disease was not observed until very late in the season and was never important. Reductions in yield amounted to possibly 40 percent in an occasional field, but for the section as a whole were probably not more than 2 percent.

Early blight (Alternaria solani (E. & M.) Jones & Grout) was somewhat less abundant than last season, probably as a result of the sprays and dusts applied for the control of late blight. However, it occurred in every field late in the season and served to hasten the death of the vines as they approached maturity.

Bacterial soft rot (Bacillus carotovorus Jones) was of slight importance either in the field or in transit this season. Better growing conditions in general, the more abundant use of copper fungicides on the foliage, and improved methods of handling the crop in packing houses are considered to be the chief reasons for reduced losses from this disease.

Virus diseases such as rugose and mild mosaic were less prevalent this season than in the previous one. A trace of eelworm damage due to the nematode Heterodera marioni (Cornu) Goodey was observed in a few fields.

Bacterial wilt (Bacterium solanacearum EFS), blackleg (Bacillus phytophthorus Appel), and southern wilt (Sclerotium rolfsii Sacc.) were not observed. (Sub-Tropical Experiment Station, Homestead, Florida).

WHITE RUST ON TEXAS SPINACH

James S. Wiant

Carlots of Texas spinach arriving on the New York, New York, market during the past four weeks have been seriously affected with white rust. The characteristic white pustules were first observed on occasional leaves. Since the time of its first appearance the disease has become more abundant as represented by an increase in the number of pustules per leaf, the number of leaves affected, and the number of plants per carlot that bore affected leaves. In a recent carlot fully three-fourths of the plants examined at random bore from one to three leaves that were slightly to severely affected.

Since no oospores have been found as yet, the causal organism has been only tentatively identified as Albugo occidentalis Wilson, by Mr. John A. Stevenson of the Division of Mycology and Disease Survey. This fungus has been occasionally reported on members of the Chenopodiaceae from the western states but so far as the Plant Disease Survey records go this is the first report of its occurrence on spinach and the fungus may be considered as rare on other plants. (Division of Fruit and Vegetable Crops and Diseases).

LEAF DISEASES OF NURSERY STOCK IN ILLINOIS IN 1936

J. C. Carter

A quantity of specimens of leaf diseases was collected in 1936 from stock growing in northeastern Illinois nurseries, by Glenn L. Pierce of the Illinois State Nursery inspection service, and submitted to the writer for identification. The determinations are listed below, and the specimens are deposited in the Mycological Collection of the Illinois State Natural History Survey.

The drought of 1936 might be supposed to have been unfavorable to the development of leaf diseases, and this was undoubtedly the case. Yet the list, including 43 hosts and 44 parasites, tends to indicate that in even the most unfavorable seasons diseases manage to perpetuate themselves.

ACER NEGUNDO L.
Phyllosticta minima (Berk. & Curt.) Ell. & Ev., leaf-spot.

A. PLATANOIDES L.
Gloeosporium apocryptum Ell. & Ev., anthracnose.
Phyllosticta acericola C. & E., leaf-spot.

A. SACCHARINUM L.
Phyllosticta acericola C. & E., leaf-spot.
Phyllosticta minima (Berk. & Curt.) Ell. & Ev., leaf-spot.

AILANTHUS GLANDULOSA Desf.
Cercospora glandulosa Ell. & Kell., leaf-spot.

AMELANCHIER CANADENSIS (L.) Medic.
Fabraea maculata Atk. (Entomosporium maculatum Lev.), leaf-blight.

CATALPA BUNGEI C. Meyer
Macrosporium catalpae Ell. & Mart., leaf-spot.

CATALPA SPECIOSA Warder
Microsphaera elevata Burr., powdery mildew.
Phyllosticta catalpae Ell. & Mart., leaf-spot.

CORNUS STOLONIFERA Michx.
Septoria cornicola Desm., leaf-spot.

CRATAEGUS OXYACANTHA L.
Gymnosporangium sp., rust.
Phyllosticta solitaria Ell. & Ev., blotch.

EVONYMUS ATROPURPUREUS Jacq.
Microsphaera alni (DC.) Wint., powdery mildew.

HAMAMELIS VIRGINIANA L.
Phyllosticta paviae Ell. & Ev., leaf-spot.

LONICERA TATARICA L.
Microsphaera alni (DC.) Wint., powdery mildew.

PHLOX sp.
Erysiphe cichoracearum DC., powdery mildew.

POPULUS ALBA L.
Marssonia castagnei (Desm. & Mont.) Sacc., leaf-spot.

P. DELTOIDES Marsh.
Melampsora medusae Thuem., rust.
Septoria musiva Pk., leaf-spot.

PRUNUS AMERICANA Marsh.
Cercospora circumscissa Sacc., shot-hole.

P. VIRGINIANA L.
Bacterium pruni EFS, bacterial spot.

PSEDERA QUINQUEFOLIA (L.) Greene
Guignardia bidwellii (Ell.) Viala & Ravaz (*Phyllosticta labruscae* (Engelm.) Thuem.), black-rot.
Uncinula necator (Schw.) Burr., powdery mildew.

PYRUS COMMUNIS L.
Fabraea maculata Atk. (*Entomosporium maculatum* Lev.), leaf-blight.
Venturia pyrina Aderh. (*Fusicladium pyrinum* (Lib.) Fckl.), scab.

PYRUS FLORIBUNDA Lindl. /Malus floribunda Sieb./
Alternaria sp., leaf-blight.
Phyllosticta solitaria Ell. & Ev., blotch.
Podosphaera leucotricha (Ell. & Ev.) Salm., powdery mildew.

P. IOENSIS Bailey /M. ioensis Britt./
Physalospora obtusa (Schw.) Cke. (*Sphaeropsis malorum* Pk.), black-rot.

P. MALUS L. /M. sylvestris Mill./
Coniothyrium pyrinum (Sacc.) Sheldon, frog-eye leaf-spot.
Venturia inaequalis (Cke.) Wint. (*Fusicladium dendriticum* (Wallr.) Fck.), scab.

QUERCUS ALBA L.
Taphrina coerulescens (M. & D.) Tul., leaf-blister.

Q. MACROCARPA Michx.
Cylindrosporium microspilum Sacc. & Wint., leaf-spot.

Q. ROBUR L.
Marssonia martini Sacc. & Ell., leaf-spot.
Microsphaera alni (DC.) Wint., powdery mildew.

ROBINIA PSEUDO-ACACIA L.
Microsphaera diffusa Cke. & Pk., powdery mildew.

ROSA MULTIFLORA Thunb.
Cercospora rosicola Pass., leaf-spot.
Sphaerotheca pannosa (Wallr.) Lev., powdery mildew.

R. RUGOSA Thunb.
Phyllosticta rosae Desm., leaf-spot.

R. SETIGERA Michx.
Phragmidium americanum (Pk.) Diet., rust.

RUBUS sp. (Blackberry)
Mycosphaerella rubi Roark, Septoria leaf-spot.

RUBUS sp. (Raspberry)
Mycosphaerella rubi Roark, Septoria leaf-spot.

SALIX AMYGDALOIDES Anders.
Melampsora bigelowii Thuem., leaf-rust.
Uncinula salicis (DC.) Wint., powdery mildew.

SALIX NIGRA Marsh.
Melampsora bigelowii Thuem., leaf-rust.

S. PENTANDRA L.
Gloeosporium salicis Westd., leaf-spot.

SORBUS AMERICANA Marsh.
Bacillus amyloworus (Burr.) Trev., blight.
Venturia inaequalis var. *cinerascens* Lin. (*Fusicladium orbiculatum* Thuem.), scab.

SYMPHORICARPOS RACEMOSUS Michx.
Microsphaera diffusa Cke. & Pk., powdery mildew.

SYRINGA sp. (French hybrid)
Microsphaera alni (DC.) Wint., powdery mildew.

S. PERSICA L.
Microsphaera alni (DC.) Wint., powdery mildew.

S. VULGARIS L.
Microsphaera alni (DC.) Wint., powdery mildew.

TILIA AMERICANA L.
Cercospora microsora Sacc., leaf-blight.

ULMUS AMERICANA L.
Gnomonia ulmea (Sacc.) Thuem. (*Gloeosporium ulmeum* (Sacc.) Miles), black-spot.

U. AMERICANA L. (Moline variety)
Gnomonia ulmea (Sacc.) Thuem. (*Gloeosporium ulmeum* (Sacc.) Miles), black-spot.

VIBURNUM LANTANA L.
Cercospora varia Pk., leaf-spot.

(Section of Applied Botany and Plant Pathology, Illinois State Natural History Survey, Urbana, Illinois.

REPORTS ON APPLE SCAB

RHODE ISLAND:

Westerly, March 30, MacIntosh variety, no sign of asci, perithecia fully formed.

Warwick, March 30, MacIntosh variety, asci just starting to form.

Kingston in the College orchard, MacIntosh variety, unsprayed during 1936.

March 30, asci just starting to form in the perithecia.

March 31, due to warm weather the asci are developing fairly rapidly.

April 2, first immature ascospores found within the asci. The buds were taking on a slight reddish color due to a few warm days. Rain in the afternoon.

April 4, a warm day, perithecia contained fully developed asci as well as some partially developed ascospores.

April 6, warm day, following a warm wet day. Perithecia seemed much enlarged or swollen. Asci and ascospores present.

April 8, warm day. Asci and ascospores present.

April 9, perithecia very much swollen. Asci present as well as many ascospores.

Greenville, April 8, perithecia small, very few ascospores present. Just starting to form. Asci more fully developed in one variety than the other.

If weather remains warm with rains falling every other day, the spores will mature very rapidly. The buds of the trees are showing considerable swelling. The protective scales are breaking apart and a fuzzy surface is protruding from the apex of the bud. No green can be seen. (Frank L. Howard, Rhode Island Agricultural Experiment Station).

NEW YORK: (from State College of Agriculture Departments of Entomology and Plant Pathology Weekly News Letter).

Hudson Valley. On March 25 ascospores were beginning to cut out and showed some coloration. These samples were McIntosh, taken at Hyde Park, Dutchess County, and at Clermont, Columbia County. Ascospores were maturing rapidly. Ben Davis leaves examined April 1 showed about the same stage of development. Crab apple leaves brought from Tivoli, Dutchess County last fall and put in wire screens on the ground at the Geneva Laboratory showed a large number of the perithecia full of mature spores and a slight discharge was obtained. There were in places as many as 14 spores under the low power microscope. (J. M. Hamilton and D. H. Palmeiter, Poughkeepsie, April 5).

McIntosh sample taken at Hyde Park, Dutchess County showed about 50 percent of the perithecia having some colored spores. Scab does not seem to be developed quite so far around Hudson, Columbia County. No spore discharge has been obtained yet. (D. H. Palmeiter, Poughkeepsie, April 12).

Western New York. Abundant colored ascospores were found shooting from the asci of crushed perithecia in McIntosh apple leaves gathered in the Reddick orchard at Ithaca this morning, April 5. Some of the materail is being tested to determine whether the scab fungus is now able to shoot spores under natural conditions. No ascospores were found on trap slides in one-half hour after the leaves were wet. (W. D. Mills, April 5).

A leaf sample collected at Albion, Orleans County, April 7th contained too few perithecia for an accurate count, but a number of perithecia were found to be filled with colored ascospores. No ascospores were found on trap slides from a portion of this leaf sample after 24 hours.

Snow has covered the ground in the Reddick orchard at Ithaca the past three days and no samples were taken. (W. D. Mills, April 12).

A sample of leaves from Niagara County examined April 7th showed about 30 percent of the perithecia contained colored spores. About half of these contained over 10 percent mature spores. There were about 3 to 5 percent of the perithecia full of mature spores. A very little spore discharge was obtained. (J. M. Hamilton, April 12).

PENNSYLVANIA: Apple scab spores matured earlier this spring than usual. This seemed to be due to the warm winter. The cold weather during the last half of March appeared to hold back the maturity of the spores. There will be a very large percentage of the scab spores mature by the time the delayed dormant spray is applied, probably about April 12 to 18.

The following tabulation shows the development of the fungus. (R. S. Kirby, Pennsylvania Agricultural Experiment Station, April 6).

Table 8. Apple scab spore maturity in southeastern Pennsylvania.

Time of collections	Total number scab perithecia examined	Number showing: no asci forming	Number with asci only: no spores formed	Number with colorless spores	Number with colored spores		
					1-10	Over 10	All spores in perithecia colored
February 15 to 28	296	214	73	8			
March 1 to 15	622	312	108	82	78	41	
March 15 to 31	415	173	88	72	50	21	
April 1 and 2	155	29	50	51	47	12	1

SEED INSPECTION FOR DISEASE CONTROL

M. T. Munn

Seed inspection in some form to control plant diseases has not been given the attention and support it should receive and really warrants. At the present time the amount of inoculum passing every year over state or national boundary lines in the form of mycelium, spores, or sclerotia upon or within seed stocks, is very great. To be convinced of that fact one has but to study the large numbers of samples of seeds passing through a modern seed testing laboratory each season. In the case of some diseases the fungus spores or other reproductive parts or bacteria are transported on the seeds or mixed with seeds and it is only when a seed stock can be obtained from growing regions where the disease does not occur and the stock is kept that way that effective control can be secured and assured through certification and sealing.

While seeds in general are probably not as frequent carriers of living reproductive forms of an organism as are the larger living plants, they are, nevertheless, very fertile media for such dissemination. Recognizing this, various forms of control and inspection have been established and put into operation. In practice the certification plan provides for field inspections of the growing plants or the crop. The crop may be apparently free of visible signs of disease yet the finished seed crop may be subsequently infected or contaminated during harvesting, curing, threshing, and other milling operations, thus in some cases the original disease-free certification of the seed crop is of little value.

If we acknowledge that the field inspection and certification of the growing seed crop is surrounded by limitations it then becomes necessary to work out and to utilize effective, practical methods of detecting the presence of disease carriers in the avenues of commerce. Only a very few seed testing laboratories or seed control stations are at present equipped with facilities and manned with a worker capable of detecting and diagnosing the seed-borne microorganisms. The findings of plant pathologists are not being put into practice in many seed testing laboratories where these vital seed stocks are under test or review.

The possibilities of plant disease control through seed inspection or certification are really just beginning. The probability of seed-borne viruses opens a large new field. In the "Rules" for seed testing of both the North American and the International Association of seed control officials, there are brief directions as to how tests for the sanitary condition of the seed stock are to be made. These tests are still very brief and rudimentary.

The committee on determination of seed-borne diseases of the International Seed Testing Association, of which the writer is a member, has done much to formulate effective methods of testing for the detection of seed-borne diseases and for the certifying and recording of the findings upon the International Certificate which is designed to accompany each shipment of seed in international commerce. At the present time these certificates which certify as to the findings and the methods used, are not mandatory but are supplied only when demanded by the importer. An examination of one of these official International Certificates shows that provision has been made for reporting thereon concerning the sanitary condition of the seed stock, yet on the reverse side of the report is a statement to the effect that, "Where no information is required as to sanitary condition of the seed, this certificate does not furnish any information." Thus it can be plainly seen that unless information is demanded it will not be supplied even though it is readily detected and is available. It appears that tradesmen find it is more difficult to deal with these certificates if a plain statement is made thereon that this seed stock was found to carry this or that disease according to this or that test or determination. These statements of fact upon the certificate unless convincingly negative, usually prove to be a hindrance or embarrassment to the exporter or seller even though there is appended the additional statement that the resultant disease can be prevented or controlled by certain named seed treatments.

The tendency then seems to be to say as little as possible about the sanitary condition of the seed stock lest it arouse suspicion about or objection to the goods, and therefore, possibly become a basis for refusal or rejection by the purchaser. Briefly, these certificates which were designed and intended to make certain and sure the description of the exported or imported seed stock deal with four very essential factors, namely, varietal genuineness, mechanical purity, viability, and sanitary condition or freedom from disease. The first three are given adequate and competent attention, but the fourth, the disease-carrying possibilities, is not being attacked as it should be. The writer believes that all dependable knowledge as to the sanitary condition of the seed stock and every safe practical diagnostic method should be used at the point of origin of the goods rather than at the destination lest delay, loss, and injury occur in the meantime. Probably examinations and inspections might also be carried out at the destinations as well as at the place of origin where such examinations seem advisable and worthwhile.

The ideal arrangement is to have provision made for adequate field inspection followed by controlled handling of the seed crop, and finally, careful testing by adequate means of the finished seed stock and a certificate to show that the named tests were at least negative. That plan appears to the writer to be the best to be hoped for at the present time. A number

of practical applications of this plan can be cited to show its efficacy. As an illustration, not many years ago large quantities of field peas badly infected with Ascochyta spp. came into New York state. Attention was focused upon the situation and by means of final laboratory tests which are not always infallible, and the cooperation of the growers and exporters, the amount of disease carried was reduced to practically zero. It is not always so easy to clear up a situation as that outlined above. The seed stocks of some of the cruciferous plants grown in certain areas under intensive long-time culture are excellent examples of the increased amount of inoculum carried yearly. For such a condition the ultimate user of these seeds must depend upon the standard hot-water seed treatment. In other words certification for disease alone could not be secured and in the end might be more expensive and less effective than seed treatment which might need to be used anyway.

It is not possible to enumerate here specific cases yet it does seem to be a fair statement of fact to say that whatever is done in the way of adequate seed certification and inspection to help control disease must be based upon a firm scientific foundation of sound biological principles fully supported by facts as to the nature of the problem to be dealt with and what it is possible to add in the way of detection, diagnosis, and enforcement. If this problem is not approached in this manner we may find ourselves surrounded by hampering or restricting regulations entirely without adequate gain. Sometimes popular demand by a fully informed group of plant growers will do more to stimulate the production of a supply of disease-free seed stock and do it more quickly than the more deliberate workings of regulations. With the present development of seed treatment methods it may be found that for a group of diseases, because of the manner and form in which they are carried, the entire emphasis may be safely placed upon final seed treatment measures as the safest and most economical procedure. Indeed, within the past several months we have seen large commercial seed companies put into operation on a large scale highly developed and widely useful seed treatment measures all circumscribed of course by the limitations of distribution, storage, and possibility of injury to the treated seed stocks. It may be shown that such procedures are highly advisable and economical even upon fully certified seed stocks.

In conclusion it seems very safe to recommend that more attention be given to disease control or prevention through seed inspection both in the field and in the seed testing laboratory than has ever been given before.

The routine seed testing laboratory operations can and do reveal a vast amount of information as to the sanitary condition of seed stocks passing yearly into trade channels and finally to growing fields. Years of scarcity and high prices when low-grade and low-quality seed stocks

come onto the market are the periods when efforts toward better agriculture suffer their greatest setback through lack of disease control.

Plant pathologists everywhere should show more active interest in the present organization of many of our state seed testing laboratories looking toward the early utilization of all present knowledge concerning seed-borne diseases, their possible detection and dissemination. Also, it must be recognized that the efforts of plant pathologists may be nullified by the promiscuous movements and sales of contaminated or diseased seed stocks.

International certificates, even though they have their limitations, should be more universally demanded with each shipment of seed stock. They serve as a source of protection and as a means of focusing attention upon the importance of disease-free seed stocks. (Division of Seed Investigations, New York State (Geneva) Agricultural Experiment Station).

MARCH WEATHER

In general, the month of March, 1937, was cooler than normal east of the Rocky Mountains and warmer than normal in the far West. East of the Great Plains the general tendency was to scanty precipitation, but above normal was the rule to the westward.

Figure 14 shows that about normal warmth prevailed along the Atlantic coast and in the Great Basin of the West, but the temperature averaged considerably above normal locally in the northern Great Plains and the north Pacific area. The largest minus departures occurred from the lower Mississippi Valley westward to New Mexico, where the monthly means were from 4° to 6° subnormal. Relatively low temperatures were experienced also from West Virginia northward, in parts of the Ohio Valley, and in some upper Rocky Mountain sections. The largest plus departures are shown for the interior of the Pacific Northwest, where the month was 4° to 7° warmer than normal. (From Weekly Weather and Crop Bulletin, for the week ending April 6, 1937).

Figure 15 shows the percentage of normal precipitation for the several States during the month of March 1937. The monthly totals were markedly subnormal in most sections east of the Mississippi River, especially in the Ohio Valley where less than half the normal amount occurred. In the Atlantic area averages ranged from about normal in the extreme North to less than half the normal in Virginia.

In the Great Plains the month had more than normal precipitation, except in the extreme northern portion. North Dakota had only half the normal, but in other Plains States the percentages ranged from 102 in

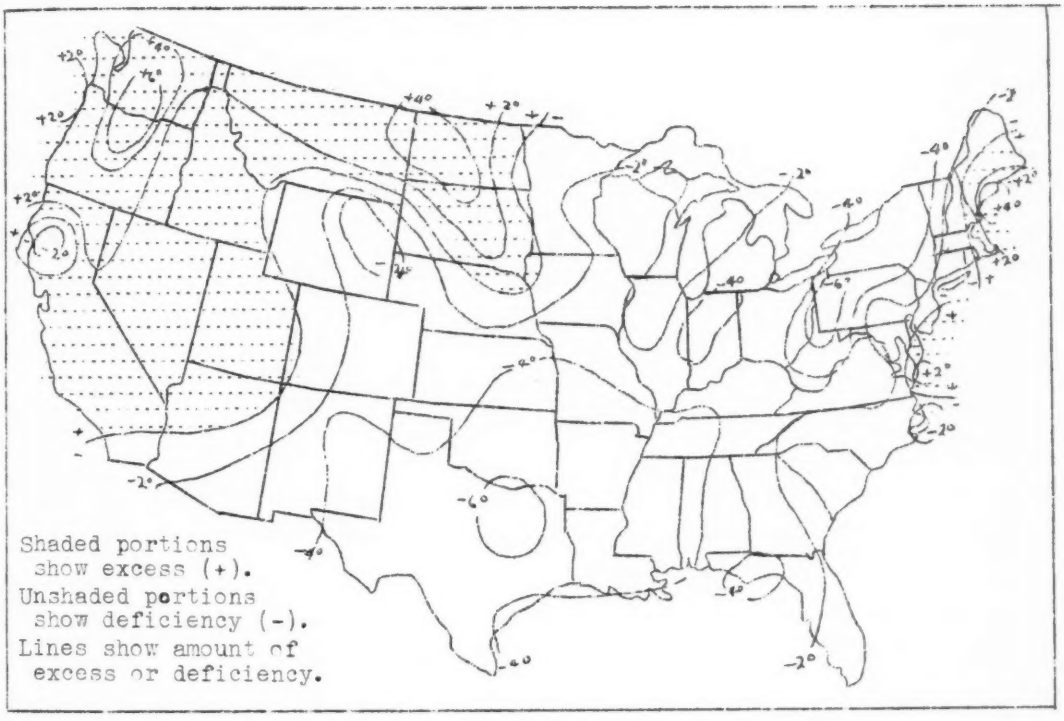

Fig. 14. Departure of Mean Temperature from the Normal for March 1937.

Oklahoma to 130 in Nebraska. West of the Plains southern sections had above normal, but northern districts were relatively dry. ("Weekly Weather and Crop Bulletin for the week ending April 13, 1937).

JANUARY-MARCH PRECIPITATION

Figure 16 shows the percentage of normal precipitation for the first 3 months of 1937; January to March, inclusive. It indicates that much the greater portion of the country had relatively abundant precipitation during this period. In fact, only 5 States--Texas, Oklahoma, North Dakota, Montana, and Washington--had less than normal, and in no case was the deficiency greater than 10 percent. East of the Great Plains all States had abundant precipitation, too much in places, while from the Rocky Mountains westward the excesses were large in southern sections.

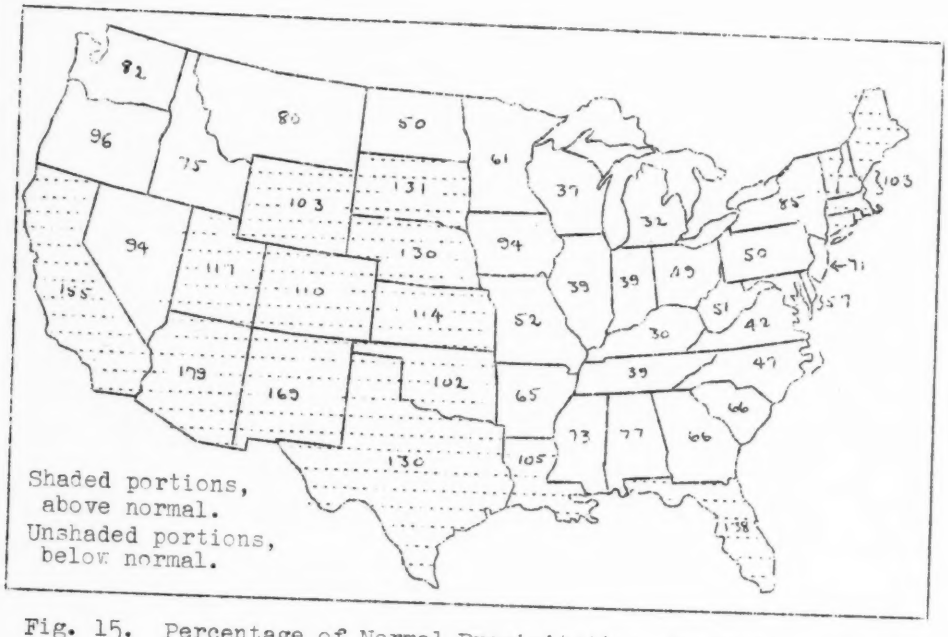

Fig. 15. Percentage of Normal Precipitation, by States, March 1937.

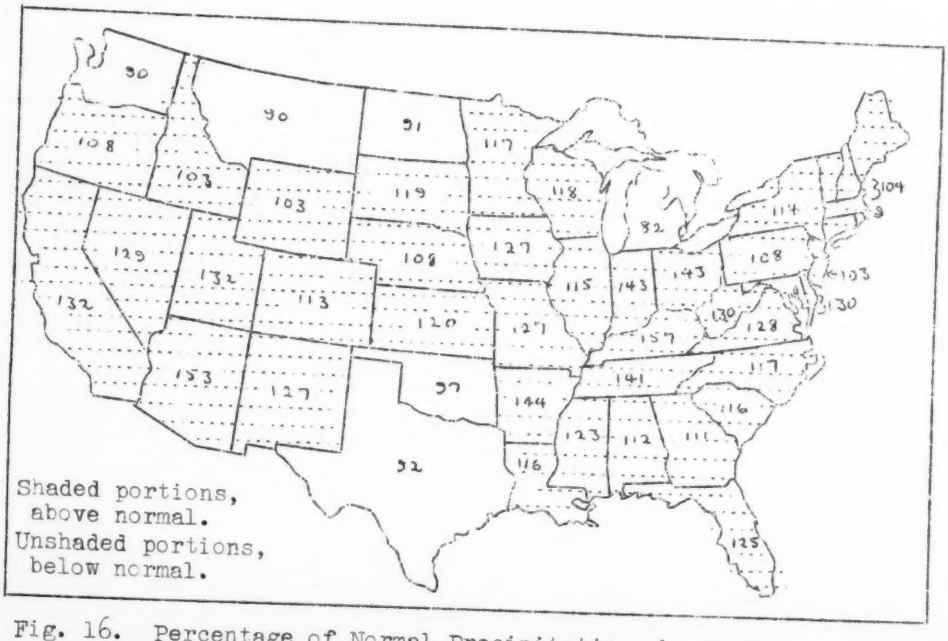

Fig. 16. Percentage of Normal Precipitation, by States, (January-March) 1937.

The contrast in rainfall for these months in 1937, compared with 1936, is pronounced in a large southwestern area. Following are some comparisons in percentages of normal, the first figures for 1937 and the second for 1936: Texas 92-43; Oklahoma 97-26; Kansas 120-35; and Missouri 127-52 percent. (Weekly Weather and Crop Bulletin for the week ending April 13, 1937).